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ABSTRACT

A new allocation model for teaching and nonteaching staff has been developed at the University of Utrecht, in the Netherlands. The model may be characterized as highly normative, leading to lump sums to be allocated to academic departments. These departments in turn are free, within constraints, to budget their activities differently than is assumed within the model. The parameters within the model are optimized with regard to a set of centrally determined requirements using a spreadsheet program on a small microcomputer. Details are given regarding the reasons for designing the new model, the design itself, the process of implementation, and the actual use of the model in the framework of the planning process within the institution. New Dutch government regulations concerning teaching staff structures are reviewed that influenced the development of the new allocation model. Objectives of the model are outlined, including the following: the model would handle all costs; it would coordinate with the general participative structure of the institutional planning process; and while block grants would be given to academic departments, the assumed costs for the various programs would remain visible. A submodel for personnel allocation is also outlined. (Author/SW)

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An allocation model for teaching and non-teaching staff in a decentralized institution

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THE ASSOCIATION FOR INSTITUTIONAL RESEARCH

This paper was presented at the Twenty-Fourth Annual Forum of the Association for Institutional Research held at the Hyatt-Regency in Fort Worth, Texas, May 6-9, 1984. This paper was reviewed by the AIR Forum Publications Committee and was judged to be of high quality and of interest to others concerned with the research of higher education. It has therefore been selected to be included in the ERIC Collection of Forum papers.

Daniel R. Coleman, Chairman
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ABSTRACT

A new allocation model for teaching and non-teaching staff has been developed at the University of Utrecht. It may be characterized as highly normative, leading to lumpsums to be allocated to academic departments. These departments in turn are free -within constraints- to budget their activities differently than is assumed within the model. The parameters within the model were optimized with regard to a set of centrally determined requirements using a spreadsheet program on a small microcomputer. Details are given regarding the reasons for designing the new model, the design itself, the process of implementation, and the actual use of the model in the framework of the planning process within our institution.

1. Introduction and historic perspective

From the end of the sixties various approaches for the construction of allocation models have been pursued within North America and Europe. Most of the comprehensive models (RRPM, CAMPUS, TUSS) were developed to get a more objective insight into the needs of the academic departments. Various reviews (see for example: Flourde, 1976;Hopkins and Massy ,1981) can be found on these models, and on the problems concerning their implementation in the institutions in which they were developed and concerning their transfer to other institutions.
At the University of Utrecht the Total University Simulation System (TUSS) was developed in the beginning of the seventies (Hussain,1976; van Noord, 1980).Besides providing information on teaching activities, TUSS was designed to give insight into the need for support staff, expenses andfloorspace (and thus on needed investment capital).

In their most elaborate forms these models require the use of thousands of data the level of the smallest activities such as classroomsize, classroom floorspace, etc. . Moreover, the cost of maintaining the databases up to date can be considerable. Finally, getting the data from the various departments has often met with hostility from the professionals within the departments out of fear that either their data would be used to cut their budgets, or that they might be required to carry out their teaching activities according to the data.

1.1. Teaching staff

These models tried to map the reality of teaching activities onto the model's structure, **under the assumption that measurements of that "reality" could be made in an objective manner.** It has been argued by Hopkins and Massy that this assumption might hold in a college that almost exclusively carries out teaching activities. When substantial research activities occur, the problems in obtaining, using and verifying data on programs or activities become insurmountable. There are two reasons for this :
(1) The research activity cannot be broken down into discrete elements for which data as size, required time of preparation, etc. can be recorded. The only reasonable magnitude for the input is the time spent on research. In practice this leads to problems such as professors having a full-time teaching load during working hours, but producing a considerable amount of research output as a result of off-hours activity.
(2) Even more important is the fact that research and education are different outputs that in research universities are produced by a joint input, i.e. time. Is the professor who is having a discussion with his staff and post-doctoral students engaged in teaching, in actual research, in managing his department ? Most professors will argue that they all occur **at the same time,** and that it is impossible and even senseless to try to separate this time into various portions. Of course, one can make assumptions on the percentage of joint input time which should be attributed to teaching, management and research, but it should be clear to all parties involved that such percentages are a reasonable compromise, not based on anything so intangible as "reality".

1.2 Non-teaching staff, the experience at the University of Utrecht

Similar problems arose with regard to the allocation of non-teaching staff within many institutions and within our university. As an example, the experience of the University of Utrecht may be illustrating. To extend the implementation of TUSS we tried to get information on the actual activities of non-teaching staff, in order to run regression analysis as a basis for funding in the years to come. Similar procedures have been followed by Bingen and Siau(1981) at the Flemish Free University of Brussels. In order to get data on the actual support staff activities we surveyed the departments in 1976. We encountered the following obstacles:
(1) Departments were unwilling to provide data on their support staff. Fear of budgets being cut as a result of the data they had provided themselves was the main reason.
(2) Not all support activities appeared to be carried out by support staff. In some departments (notably mathematics) many professors performed their own secretarial work .
(3) Some support staff was actively engaged in research, sometimes reaching a professional level equal to graduates.
(4) The results of regression analysis were very much questioned by the departments themselves. A department with more support staff than indicated by the obtained expressions would claim this to follow from its special and unique character, severe damage being done if ,what the expression "showed" to be "fat", would be trimmed away. Other departments cried for reallocation, because now finally "evidence" was at hand to show that they had been underbudgeted for a long time.

We feel that the use of regression analysis itself within an institution for obtaining model parameters can be questioned seriously. It
tends to attach a normative value to a historically grown pattern. Is the discrepancy in the ratio of support staff to teaching staff between natural and social sciences a result of a sequential growth pattern, or is it inherent to the different characteristics of the fields?
Sizer(1979) has argued that models which are built on immediate past practice can function only effectively in expanding situations. Our experience with TUSS and especially with trying to build sub-models for support staff is concurrent with this. As long as there is still room for expansion for every department, the relative discrepancies are not important enough to wage prolonged arguments over. However, as soon as the threat of reallocation of staff posts becomes imminent, the willingness to cooperate in data acquisition and model construction disappears.

In 1978 we had to leave this track towards obtaining an allocation model for support staff. Until 1983, lacking a better method,we simply kept the historically grown ratio of support staff to academic staff constant. This was very unsatisfactory, the historic ratios being questioned for similar reasons as mentioned above. A better allocation method was clearly needed.

1.3. The rise of decentralization and deregulation

Under Dutch university government regulation laid down in University Government Reform Act (for an account of university governing structures in the Netherlands, see Daalder (1982)) the academic faculties are highly autonomous with regard to the actual content of their teaching and research programs. The central university administration , however, is responsible for budgeting the faculties and for administering all personnel affairs. In the seventies these responsibilities gave rise to detailed central instructions on how to proceed within the departments in matters such as appointment and promotion of teaching and support staff (with the exception of course of full professors) , the number of teaching and support staff being allocated to the departments, and the salary levels of the allocated positions. (In the meantime the central staff grew!)
In the course of the last ten years gradually some of these responsibilities have , maybe not in principle but in fact, been eroded. Central university offices often are not capable of countering the departments in their wishes for new appointments, and could only marginally review departmental proposals for appointments or promotions. Again, in times of expansion this was not experienced as a problem. However, when zero-growth moved in at the end of the seventies, and even more so when retrenchment hit in the eighties, the ineffectiveness of central offices became apparent.
At the University of Utrecht in the meantime total enrollment has risen to about 25,000, total employment to over 7,500 within 17 departments plus the central administration with some departments consisting of over 1,000 persons.
Both the size of some departments, and the inability of the central administration to be effectively involved in managing the academic departments have made it highly desirably to decentralize many of the administrative duties.
Together with the autonomy of the departments over teaching and research this has resulted in the introduction of block grant allocation for personnel costs to the academic departments since 1979, the departments themselves being responsible for allocating these funds to the activities within their departments. Until the introduction of the allocation models to be described below annual allocations were based on last year's appropriation with only marginal adjustments, and with poor justification for the level of appropriation itself. In times of retrenchment this policy was no longer acceptable within the political setting of the university.
Therefore, the problem was to devise allocation models, and procedures for negotiations on budgets between central administration and the academic departments, but without having to go into great detail into the operational levels within the departments.

1.4. Conclusion

We concluded from all this that we should design a highly normative model with low data requirements, together with a high level of internal freedom for the academic departments in spending their budget.
Beside the internal reasons for building new allocation models there were two national higher education policy issues which made

it even more urgent to do so. These will be discussed in the next section.

2. National policies in Dutch higher education

2.1. New Government regulations concerning teaching staff structure

Because of the need to expand the universities in the sixties and early seventies rapidly within a tight labor market, promotion policies were adopted in 1963 that were very favourable to academics. After only two (later four) years on non-tenure, tenure was granted . This procedure was in accord with standard Dutch government regulations for all government employees. As much sense as this might be for government agencies it proved to be desastrous for the quality of academic staff in many disciplines. Promotion policy was such that after about ten years an assistant professor was almost automatically promoted to associate professor. Only the number of full professors was fixed by the Ministry of Education, full professors being appointed by the Queen for a lifetime (with a mandatory retirement at the age of 70).
The obvious disadvantages of these policies were noted by university officials as early as 1970, but it took until 1981 before the government announced new regulations for the structure of the academic staff. These regulations will become effective July 1, 1984. Briefly, the new regulations comprise the following:
(1) In fact the government acknowledged that it was not possible to base university staff structure on a standard sequence as used in civil organizations :
- analyze the various tasks and activities,
- group activities of comparable levels together into positions,
- attach salary levels to these positions,
- establish required qualifications for the positions,and
- appoint qualified persons.

Investigations had shown , for many academics to little surprise, that almost all academics engaged in similar activities, and that it was impossible to attach salary levels in an objective manner to the positions that were apparently present within the faculties.
(2) On the other hand one of the objectives of the Ministry of Education was to lower the average salary level considerably.
(3) Therefore the Minister of Education, after having consulted the universities, decided that in the future for every university the number of positions for full professors is to be fixed at simply one for every seven academics. The number of associate professors will be 1.5 times the number of full professors, while assistant professors and graduate research assistants will make up for the remaining positions. Thus, relative ratios have been established to be 1:1.5:4.5 for the three groups involved.
(4) Universities will not be obliged to fix the same ratios for every academic department, down to the lowest levels within the institution.
(5) The mandatory retirement age for full professors was reduced to 65, which is the age at which most Dutch citizens retire.

The effect of the past policies combined with the new regulations will be that the numbers of both full and associate professors are to be reduced within the next 10 years to about 60 % of their

present numbers.

2.2 The national process of program review and concentration

Since the end of 1982 the Ministry of Education has, in cooperation with the universities embarked on a process of reviewing the teaching and major research programs in order to cut programs in some universities. Details of the procedures and effects have been given by Acherman(1983). For the University of Utrecht this has meant a total cut of about 13 % of the 1982 budget to be effected in the next four years. Fortunately, a large share of the cut had already been anticipated by the university administration (Dijkman and Savenije, 1983), resulting in a very uneven distribution of the necessary reductions among the academic departments. This meant that a procedure of adjusting the 'old' budgets should be developed on a basis of planned integral activities instead of on a historically grown pattern.
Within the political setting of the institution it also meant that central administrative offices should be cut at least as much as the academic departments together. Therefore, models that would require a great deal of central staff time to build and maintain the necessary data base were out of the question.

3. Model considerations and overall model structure

3.1 General considerations on model structure

Hopkins and Massy (1981) have given a number of rules to which modelers should abide in order to be succesful. They make the following points:
(1) The structure of the model should be clear to all parties involved : details may be complicated but the characteristics should be clear and simple to effect acceptance of the model; participants in the planning process should never feel that the model is like a black box which yields results in some mysterious and uncontrollable way.
(2) The model should be complete with regard to the important issues that have to be dealt with. Either these issues should be addressed visibly by the model, or they should explicitly be left out for decision makers to take into account.
(3) In principle it should be possible for a dedicated administrator to obtain model results using a simple pocket calculator.
(4) The model should be stable. This means that a small change in inputs should not lead to unpredictable or large changes in outputs.
(5) The model should be flexible. It should be valid under varying policy options, and allow for simulation purposes. It should also be easily adaptable .
(6) Communication with the model should be easy, and accessable to administrators and other participants in the decision making.

3.2 Human factors

Mayo and Kallio(1983) have stressed the importance of human factors in the process of designing and implementing new models. They point out that new models represent an innovation and intervention in a familiar and known pattern of decision making. New models do not appear upon the stage as a welcome and sought-after tool; they enter as competitors to traditional thought

structures which rely on existing information and routines for using it. Together with our own experience their points have been very useful in the process of design and implementation. In section 4. we will come back to this.

3.3 Model conditions within our institution

Besides the model conditions mentioned above, the following objectives were set for the allocation model:
(1) In the end the model should handle all costs, i.e. personnel costs including fringe benefits resulting from government collective agreements , expenses and investment in all research equipment except the extremely expensive equipment, and floorspace. In the end these cost items would be put together in one lump sum with as few constraints as to actual spending as possible. Departments would, however, be required to present planned allocation of budgets to programs within their departments in order to prevent large, unplanned shifts from one year to another.
(2) It had to fit in with the general participative structure of the planning process within the institution (Dijkman and Savenije,1983) ;
(3) It should redress one of the main deficiences of the old personnel allocation system . Previously ,reallocation procedures were designed to bring about equity with regard to the average teaching load among the academic faculties. To avoid instability due to fluctuations, a bandwidth in teaching load was considered to be acceptable with 65% (including preparation time) as the upper bound, and 50 % as the lower bound (Dijkman and Savenije, 1983). This procedure resulted in less time for research, when student numbers were rising, and the upper bound had not yet been reached. Separate handling of teaching and research was needed.
(3) It should yield proposed block grants to be given to academic departments ; however, the assumed costs for the various programs should remain visible.
(4) the model should contain as few different parameters as possible, provide for as little differentiation among the departments as was still consistent with generally agreed differences;
(5) the model should provide a basis for assigning a limited number of positions for full professor and associate professors in such a way as was consistent with the overall limits set by the Ministry of Education;
(6) total allocations should not exceed the university's total budget capabilities, nor should it result in specific departmental allocations that were wildly different from previous allocating methods.
(7) as the model would not be introduced at one instant, it should be of modular and flexible structure;
(8) use of the model should not rely on large computational facilities.

All the considerations together led us to develop the model on a microcomputer using the Multiplan spreadsheet program. This spreadsheet has as advantages over other packages that
- various data sheets can be linked together, providing for a modular structure of the complete model,
- download from mainframe data is possible through the use of a special file format code.
Another advantage was that thus the model could be easily made available to other participants within the university, an almost

necessary condition within a decentralized institution, where negotiations on budgets , inputs and parameters play an important role in the decision making process.

In the following section only the design and structure of the modules for personnel costs is described.

3.4 The submodel for personnel allocation

The allocation of personnel for different programs may be represented by the matrix A, where A_{ij} gives the ratio of (both academic and support) staff positions of type j to every full-time-equivalent academic staff position in program i. (the ratio's for academic staff add up to 1).
In the model all activities have been grouped into seven programs (1,2,...i,..7):
- undergraduate teaching
- graduate programs
- training Ph.D programs
- necessary research activity to maintain educational program quality
- management of the department
- research projects
- community service and health care

Personnel has been differentiated into 8 types (1,2,...j,..8):
- full professors
- associate professors
- assistant professors
- research assistants(teaching less than 25 % of their time)
- teaching assistants
- clerical and administrative staff
- technical and laboratory staff
- library staff

The 17 departments have been grouped into five clusters (natural sciences, socials sciences and arts and languages, medical sciences, mathematics and computer science, and geography).

The following steps may be distinguished:
(1) Total academic staff f.t.e. are considered. For undergraduate and graduate programs a standard cohort technique is used combined with normative student/staff ratio's. For these programs a base allocation of 4 f.t.e. is provided independent of student numbers.
Time for research to keep up with current developments in the field is normatively set (not for each individual professor but for the department as a whole) at 35 % of teaching f.t.e. . Time for academic management is set at 10 % of the fte needed for teaching and the research indicated above.
The total volume for specific research projects is a negotiated quantity in which external peer review procedures guarantee program quality for each of the research projects. If a department fails in submitting enough research programs of sufficient quality (according to the external reviews) this volume will be reduced.
The volume of activities in community service and health care are also negotiated.
In Table I. we have given an example for the department of phy-

sics in the 1985-89 quinquennial plan now being drawn up.

(2)For each program, normative staff of type j is calculated:

$$F_j = \sum_i A_{ij} P_i$$

(3) Total normative budget is calculated as:

$B = \sum F_j C_j$, where C_j is the average salary cost for personnel of type j.
As salary levels are subject to government regulations, these averages are close to the actual cost levels for the types of personnel considered.
In Table II. these steps are presented for the department of Physics in the 1985-89 plan.
(4) The model results provide the constraints to which the departments will have to abide in their internal policies of allocating resources to various programs. As stated above, in order to give as much internal freedom as possible the constraints set are such as required to comply with the overall ratios as required by the national government. They comprise:
- the departments will accept at least the number of freshmen students as indicated in the plan.
- the departments have to account for at least the number of f.t.e. academic staff agreed on for high quality research projects.
- the number of full plus associated professors will not exceed the sum of the computed sum for these staff types.
- the number of research assistants will not fall below the computed number.

In table III we have compiled these constraints for the department of Physics.

In section 4. we will discuss the way in which these normative results are used in the actual planning process.

4. The process of design and implementation

In line with the arguments presented by Mayo and Kallio and in view of the political nature of the allocation process within the decentralized structure of the institution it would have been very unwise to develop the model in isolation, and then throw it at an unsuspecting university. In the course of designing and discussing the potential use of the model we found that some very important issues should be kept in mind.
(1) We had to stress at all times and everywhere that the model was meant to become a decision support tool for administrators. Within the Board of Directors, the Vice-Presidents for academic affairs (which have a research career behind them) were very much opposed to a decision making model. They, and many departments were afraid that valid qualitative arguments would in the future be drowned by "computer evidence". It was important to state at all times (even to ourselves as modelers being focused on the quantitative aspects of the model !) that not models but people should make decisions, and that the use of the model within the university should be to provide a rational basis for discussion, instead of trying to convince people that the model was "honest", or "objective".
(2) To stay in line with standard procedures for consultation

with the departments and the University Council we decided to synchronize introduction of the model with the annual process of consultation and decision making on the rolling quinquennial plans. Thus, every next step would have to be legitimized by formal decision making bodies.
The approval on the overall structure of the model was to be achieved in the first annual cycle, while construction and implementation of the submodels for personnel allocation and operating expenses was scheduled for the next cycle.
(3) Each cycle consisted of continuous discussions with the Vice-Presidents for Planning and for Personnel and with colleagues from other central administration offices, followed by formal consultations with the academic departments and with the Standing Committee on Planning of the University Council. After these rounds final proposals were drawn up, and decided upon by the University Council, which is within Dutch universities the supreme decision making body on planning and budgeting.
The overall model structure and the considerations which were relevant for model design were incorporated in the Quinquennial Plan 1984-88 which was adopted by the University Council in May, 1983. At the same time the normative values need for step 1 in the submodel for staff allocation were approved.
Approval and use of the submodel for staff allocation is an integral part of the Plan for 1985-89. Although not having been approved formally today, the process of consultation of the various parties involved makes adoption extremely likely.

Some other points of the process merit attention:
(4) The discussions on the personnel submodel focused on the determination of the values in the matrix A. In view of the arguments presented in previous sections we consciously did not try to fix these values through an assessment of "actual" or "measurable" "reality", out of fear that this would lead to prolonged discussion on the validity of data and which would not solve the conflicts of interest between the departments anyway. Instead, initial sets of values were obtained by "informed judgment", informal consultations with officials from several academic departments, and common sense.
(5) Using the Multiplan spreadsheet program these values were refined until they met the conditions and constraints laid out above. Possibly the same results could have been obtained by a linear programming technique. Spreadsheet programs, however, have as a formidable advantage that one can fix, tighten and relax constraints quickly and interactively, and immediately view the effects on the resulting figures. One can investigate the boundaries of the space of possible solutions very efficiently, gaining insight into the model's peculiarities very fast.
(6) As expected, after a first version of the completed model had been approved by the University's Board of Directors (President and Vice-Presidents) and sent to the academic departments to receive their opinion, many departments had objections against details of the model mostly because some specifics of their department were not adequately represented in their opinion, claiming that more differentiation in values among the departments was needed (this being part of the political game) . However, it has not been very difficult to stick to our idea of using few parameters with similar values across the university.

(7) In setting planned allocations for the 1985-89 quinquennium we used as main considerations
- whether or not the department was central to the university's mission or strategic position,
- the computed model results for 1989,
- the actual budget for 1984, and how much it differed from the computed 1989 budget,
- the planned budgets for 1985-88 that were indicated in the previous plan for 1984-88, in order to avoid unnecessary changes in the first two years of the planning period that might be only confusing,
- whether or not the department was already accommodating substantial budget cuts,
- whether or not the department was involved in an major internal reorganization process which might lead to lay-offs, and which might be offset by sudden changes in allocation perspectives.

In Table IV we have presented the planned allocations in the 1984-88 plan, the computed results for 1989 , and the planned allocations in the 1985-89 plan.
Inspection of Table IV reveals that these considerations lead in many cases to planned allocations different from model results, and that the evolution of the allocation within the planning period has often been chosen in accord with the previous plan. In cases of rapid growth (Law, Computer Science, Pharmacy), or retrenchment (Biology, Medicine, Veterinary Science) the model has proven very useful to obtain indications for the planning period.

5. Some conclusions

Basically, the system described in the previous sections is an acknowledgement by central administrators and by academic departments that
- the central administration does not know what is best for the departments,
- the professional educators and researchers can do a better job of decisionmaking within their departments, especially when tough decisions have to be made ,
- these professionals show more loyalty to their discipline than to their institution, or to other disciplines,
- the central administration has to regulate as little as possible to remain in accord with the university's mission and its strategic position.

We feel that using a highly normative model with few parameters as a decision support tool represents an acceptable compromise which can acknowledge the political and qualitative nature of the planning and budgeting process in a large research institution. In our experience the adoption and use of this model is a significant step forward in the management of our institution with its decentralized character and democratic, participative decision making process.

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TABLE I. Size of programs for the Department of Physics planned for 1989.

entering freshmen:	1984	1985	1986	1987	1988
	115	115	115	115	115

cohort retention:	first yr	second yr	third yr	graduating
	1.00	0.80	0.75	0.70
incl. 10 % repeats	1.10	0.88	0.83	0.77

Undergraduate teaching workload 1988/89 in f.t.e.

# students 1988:	411
marginal ratio:	20
stud. indep. staff:	6.0
needed for physics:	26.6
Service teaching:	
to other depts:	4.5
by other depts:	2.4

Teaching load: 28.7 f.t.e. academic staff

Graduate student teaching load 1988/89 in f.t.e.:

# students 1988:	30
integral ratio	20

Teaching load: 1.5 f.t.e. academic staff

Coaching Ph.D.students:

	1980	1981	1982	1983	4 yr total
# Ph.D's granted	22	18	25	23	88

Coaching hrs/ Ph.D: 400

Coaching per year: 4.9 f.t.e. academic staff

Normative budgeted time for research to maintain program quality:

35% undergrad.load	10.0
35% grad.studs load	0.5

Research time: 10.6 f.t.e. academic staff

Normative budgeted time for management by academic staff:

10% undergrad.load:	2.9
10% grad.studs load:	0.2
10% Ph.D.coaching:	0.5
10% research for ed.	1.1

Management time : 4.6 f.t.e. academic staff

Negotiated volume of basic research projects of high quality:
62.0 f.t.e. academic staff

Negotiated non-normative support programs: 260 k$

Table II. Computation of lump sum for the Department of Physics in'1989.

Matrix A to convert academic staff per program to personnel categories:

natural sciences	full professrs	associate professrs	assistant professrs	research assist.	teaching assist.	admin. staff	techn. staff	library staff
undergrad.teaching	0.10	0.20	0.50	0.10	0.10	0.10		0.05
grad.studs teaching	0.20	0.30	0.30	0.20		0.10	0.10	0.05
coaching Ph.D.studs	0.40	0.40	0.20					
research for educati	0.10	0.30	0.50	0.10		0.25	1.00	0.05
comm.serv.&health	0.10	0.15	0.65	0.10		0.15		0.05
management	0.40	0.30	0.20	0.10		1.00		
research projects	0.13	0.17	0.20	0.50		0.35	1.00	0.05
k$ per fte	47.9	38.7	31.3	19.1	15.9	18.3	18.3	16.2

academic programs	size in acad.fte	cost in k$
undergrad.teaching	28.7	932
grad.studs teaching	1.5	58
coaching Ph.D.studs	4.9	200
research for educati	10.6	508
comm.serv.&health	0.0	0
management	4.6	261
research projects	62.0	3352
total	112.2	5461

Normative budge ed personnel:	positions in f.t.e.	cost in k$
full professors	16.1	770
associate professors	23.2	897
assistant pro'essors	34.3	1073
research assistants	35.7	680
teaching assistants	2.9	46
total acad. staff:	112.2	3466
admin. staff	31.9	583
technical staff	72.7	1328
library staff	5.1	83
total supp. staff:	109.8	1994
Total	221.9	5461
non-norm.programs		260
Computed budget:		5721

resulting ratio's:	full professor	associate professor	ass.profs+ res. ass.	total
	1.03	1.49	4.48	7.00

time distribution over programs(%)	full professor	associate professor	assistant professor	research assistant	teaching assistant
undergraduates	18	25	42	8	100
graduate students	2	2	1	1	
Ph.D.students	12	8	3	0	
research for educati	7	14	15	3	
comm.serv.&health	0	0	0	0	
management	11	6	3	1	
research projects	50	45	36	87	
total time	100	100	100	100	100

Table III. Constraints applied to the Department of Physics

entering freshmen:	1984	1985	1986	1987	1988
not more than	115	115	115	115	115
account for at least	62 f.t.e. in high quality basic research pr				
maximum number of full or associate professors:				39 f.t.e.	
minimum number of research assistants:				36 f.t.e.	
Budget planned for 1989 :	5825 k$				

Table IV. Comparison of planned allocations in the 1984-88 plan with model

	Allocations in the 1984-88 plan in millions of $					budget compute with model	Allocations in the 1985-89 plan in millions of $					perc. change 1989 over 1984	perc. change 1989 1988 (old plan)
	1984	1985	1986	1987	1988		1985	1986	1987	1988	1989		
Theology	1.5	1.4	1.4	1.4	1.3	1.3	1.5	1.4	1.4	1.4	1.4	-9	4
Law	5.7	5.7	5.7	5.7	5.7	6.5	5.9	6.1	6.3	6.5	6.6	16	16
Medicine	20.1	19.7	19.4	19.0	18.6	17.9	19.7	19.2	17.9	17.9	17.9	-11	-4
Computer Science	0.4	0.5	0.6	0.7	0.7	1.0	0.5	0.6	0.7	0.9	1.0	150	39
Mathematics	2.4	2.4	2.4	2.4	2.4	2.5	2.4	2.4	2.4	2.5	2.5	5	5
Physics	6.5	6.3	6.1	6.1	6.1	5.7	6.3	6.1	6.1	6.1	5.8	-11	-4
Chemistry	6.6	6.5	6.3	6.3	6.3	6.2	6.4	6.4	6.4	6.4	6.4	-4	0
Geology	4.7	4.6	4.6	4.6	4.6	4.7	4.7	4.7	4.7	4.7	4.7	-1	2
Biology	9.5	9.2	8.9	8.6	8.4	7.2	8.5	8.5	8.5	8.3	8.0	-16	-4
Pharmacy	2.5	2.5	2.5	2.5	2.5	3.3	2.7	2.9	3.1	3.2	3.4	33	36
Arts&Languages	11.7	11.3	11.1	10.8	10.8	11.1	11.3	10.8	10.8	10.8	10.8	-8	0
Social Sciences	12.6	12.2	11.8	11.4	11.0	10.8	12.2	11.1	11.1	11.1	11.1	-12	1
Veterinary Science	15.8	15.7	15.5	15.4	15.2	14.4	15.5	15.2	14.9	14.7	14.4	-9	-5
Philosophy	0.9	0.8	0.8	0.8	0.8	0.9	0.9	0.9	0.9	0.9	0.9	1	10
Geography	3.2	3.2	3.2	3.3	3.3	3.3	3.2	3.2	3.3	3.3	3.3	4	0
Total	104.2	102.1	100.4	98.8	97.7	96.9	101.6	99.5	98.2	98.3	98.1	-6	0